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Nguyen et al.

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(54) **ELECTRICAL CONNECTOR SYSTEMS**

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H01R 13/648 (2006.01)

(52) **U.S. Cl.**
USPC **439/607.34**

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USPC 439/607.34, 607.01, 607.07, 607.1, 439/607.11, 701, 61, 95, 108, 79, 101
See application file for complete search history.

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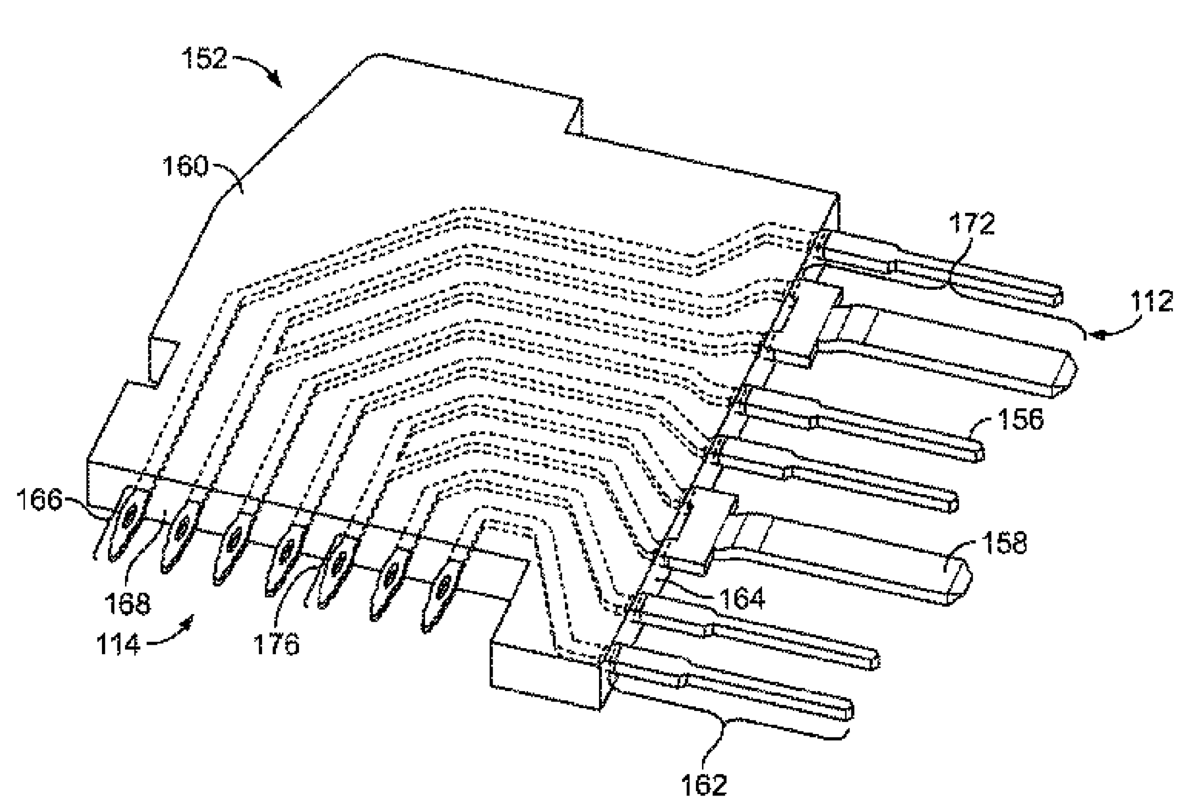
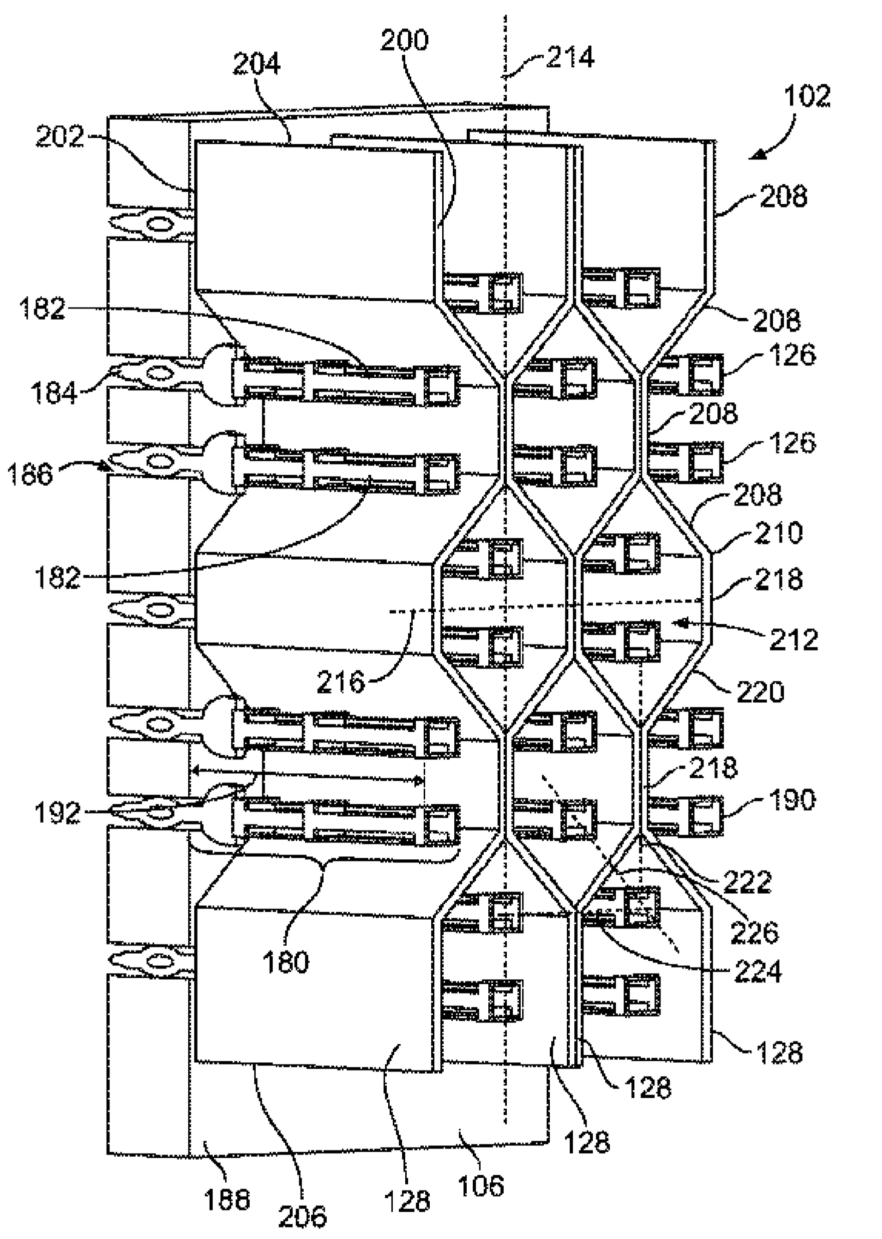
Primary Examiner — Edwin A. Leon

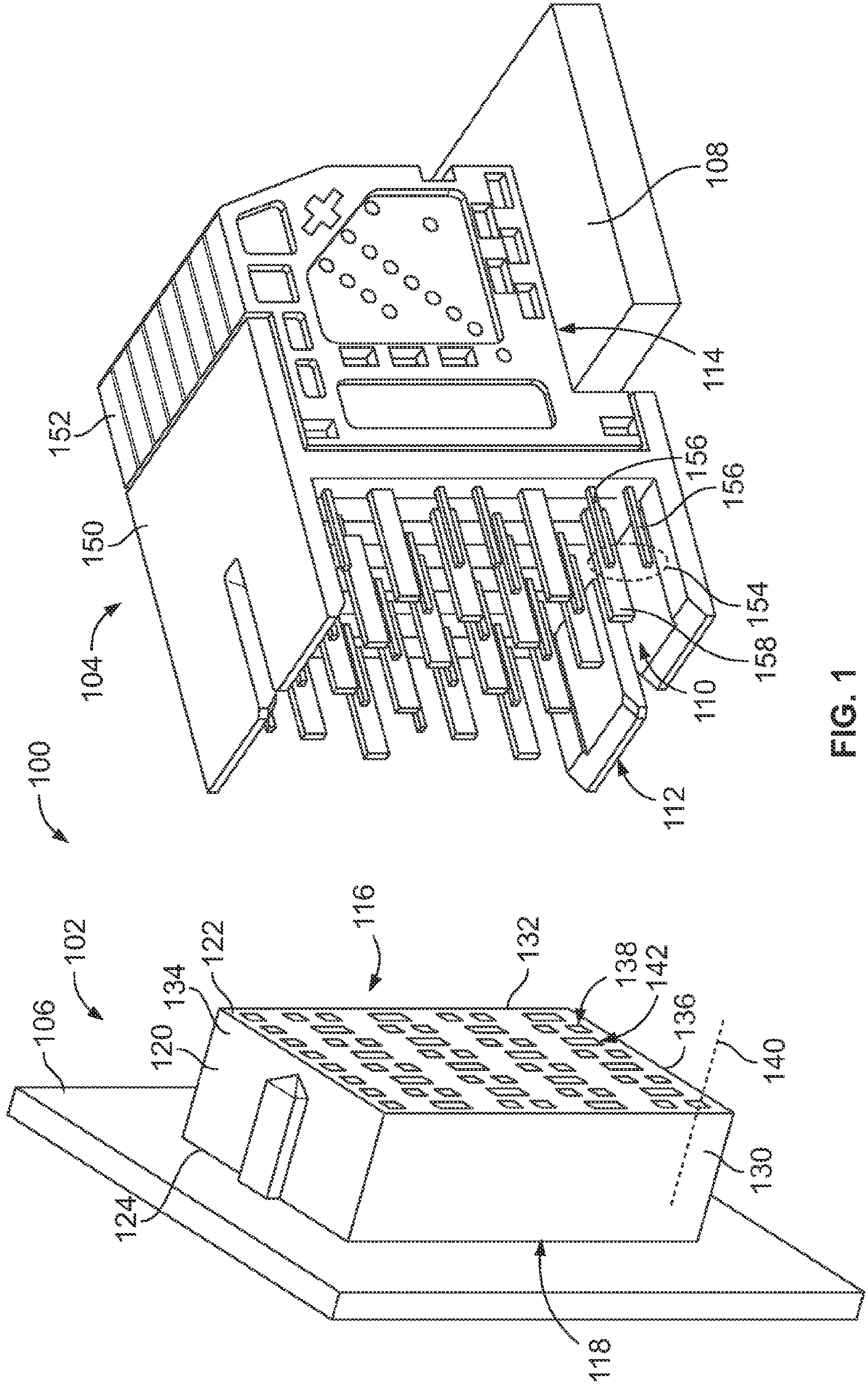
(57) **ABSTRACT**

An electrical connector system includes a backplane connector having a housing, signal contacts held by the housing and shield plates held by the housing. The housing includes a front and a rear. The housing includes signal channels extending along mating axes thereof between the front and the rear. The signal channels receive corresponding signal contacts. The housing includes slots that receive the shield plates. The signal contacts extend along the mating axes and are arranged in pairs carrying differential signals. The shield plates are electrically conductive and extend generally parallel to the mating axes between corresponding pairs of signal contacts to entirely peripherally surround the pairs of signal contacts to provide electrical shielding for the pairs of signal contacts.

20 Claims, 6 Drawing Sheets



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102
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108
110
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158

FIG. 1

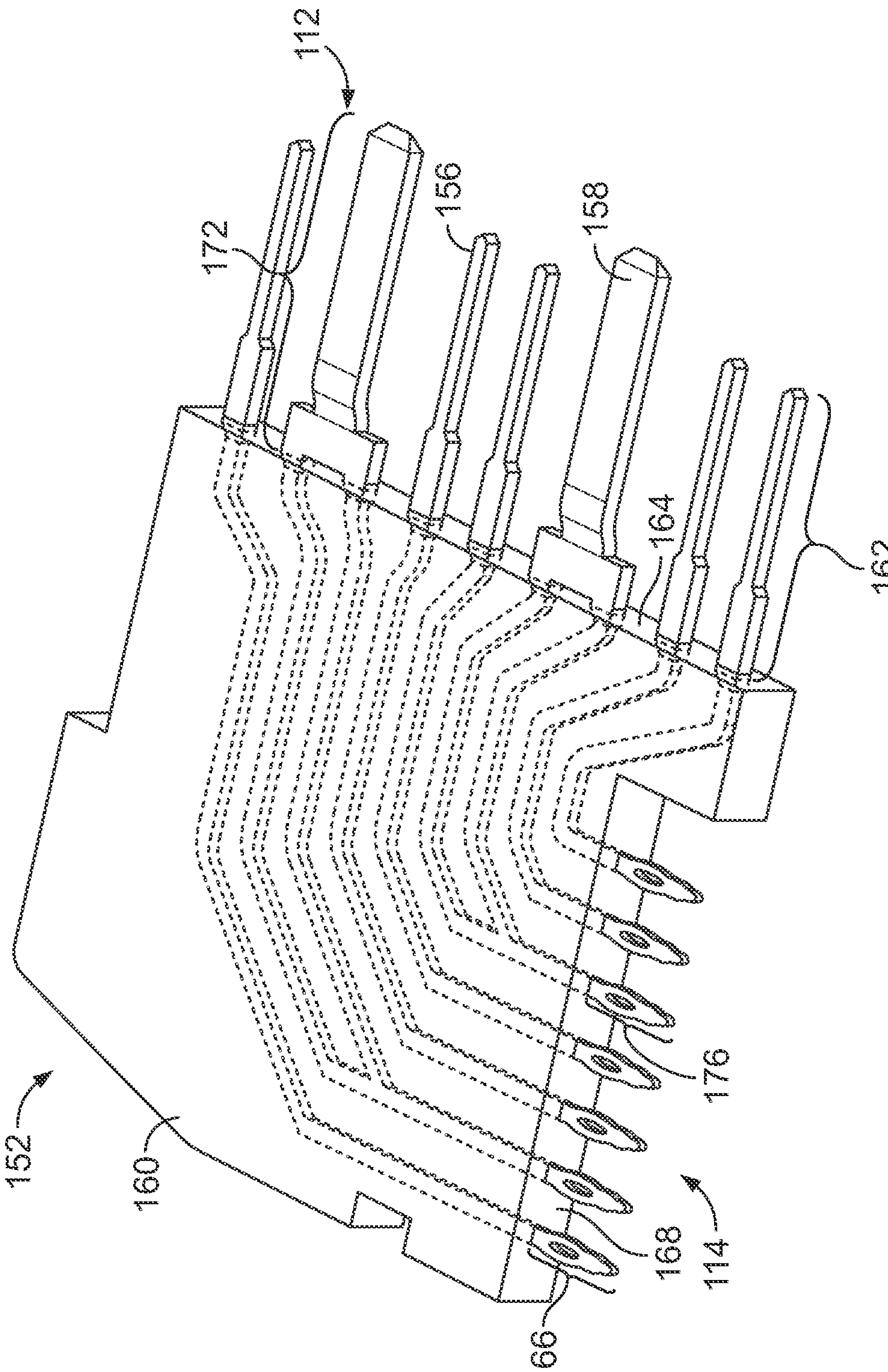
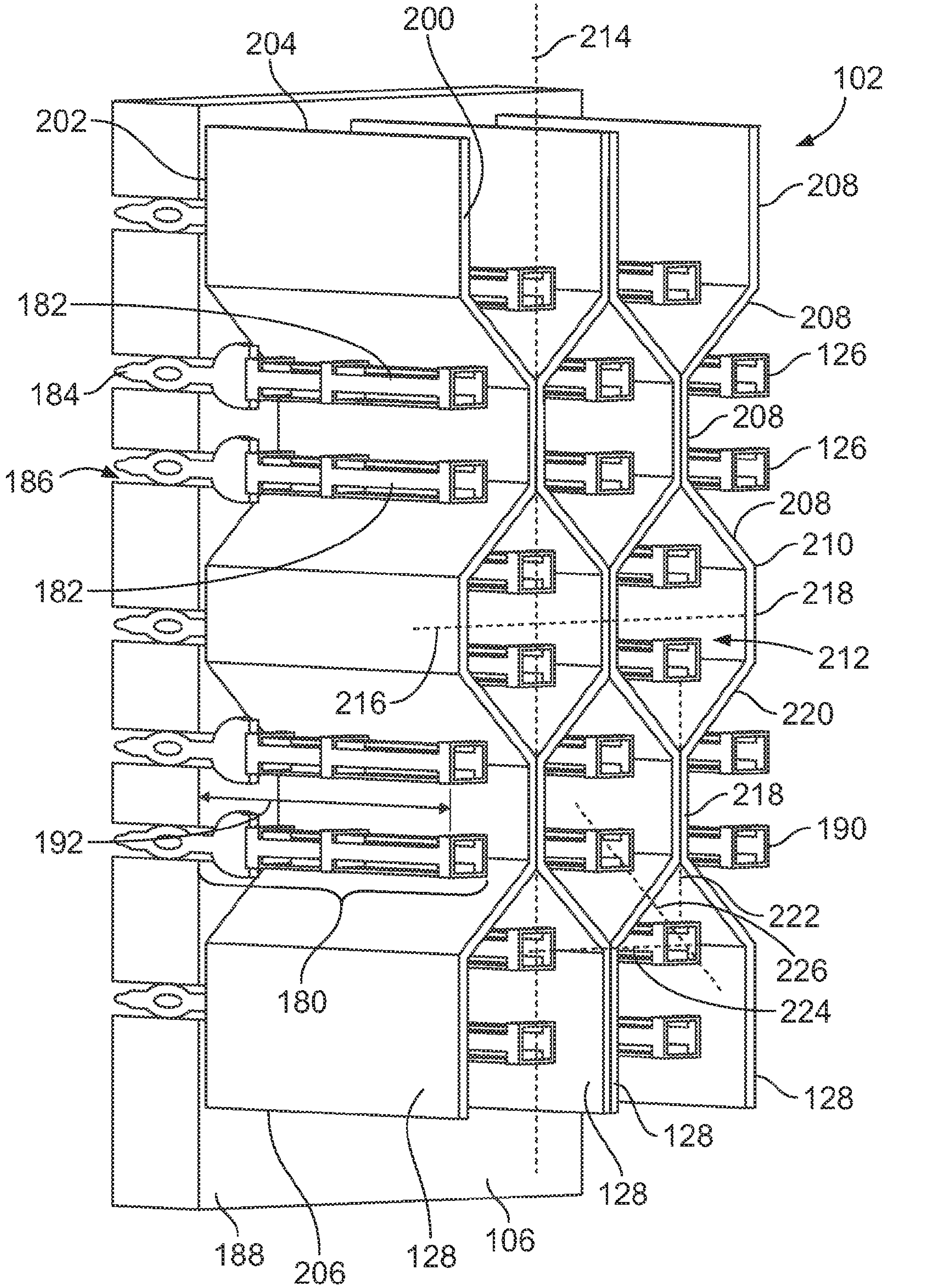


FIG. 2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204
214
102
202
208
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190
192
222
226
180
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128
128
128
188
206
128
106

FIG. 3

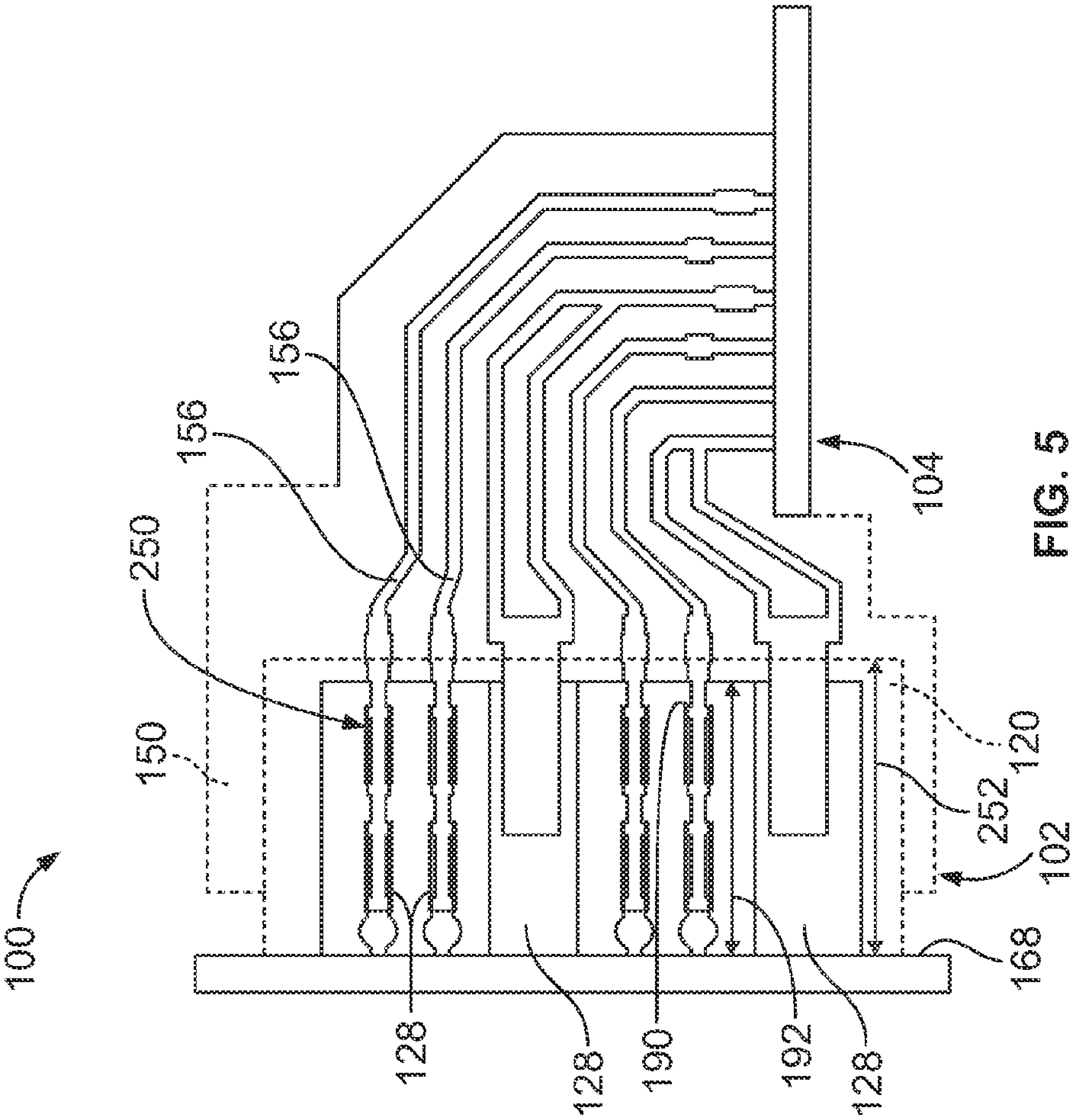
100
150
250
156
156
104
120
252
102
168
128
128
190
192
128

FIG. 5

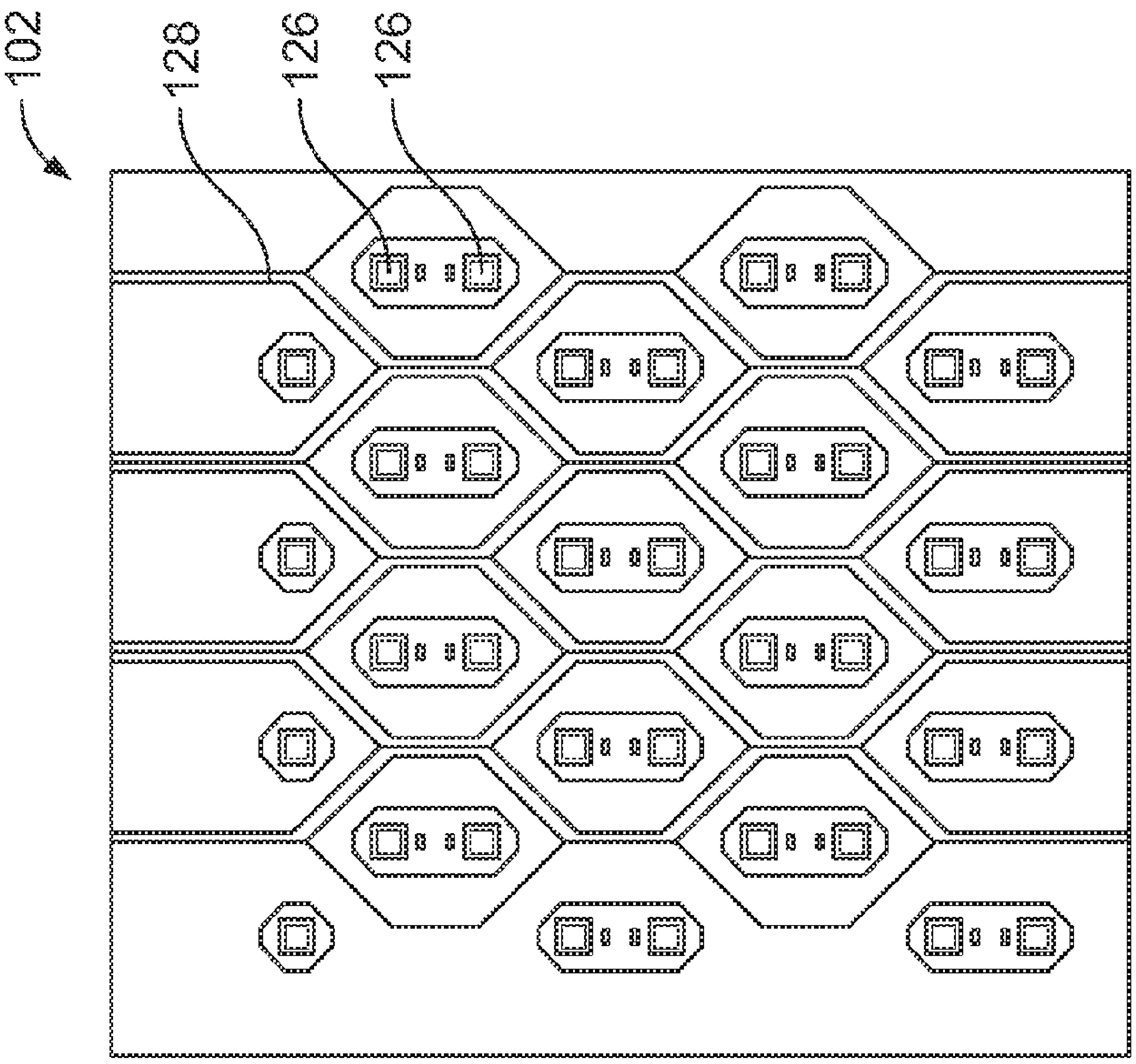
102
128
126
126

FIG. 4

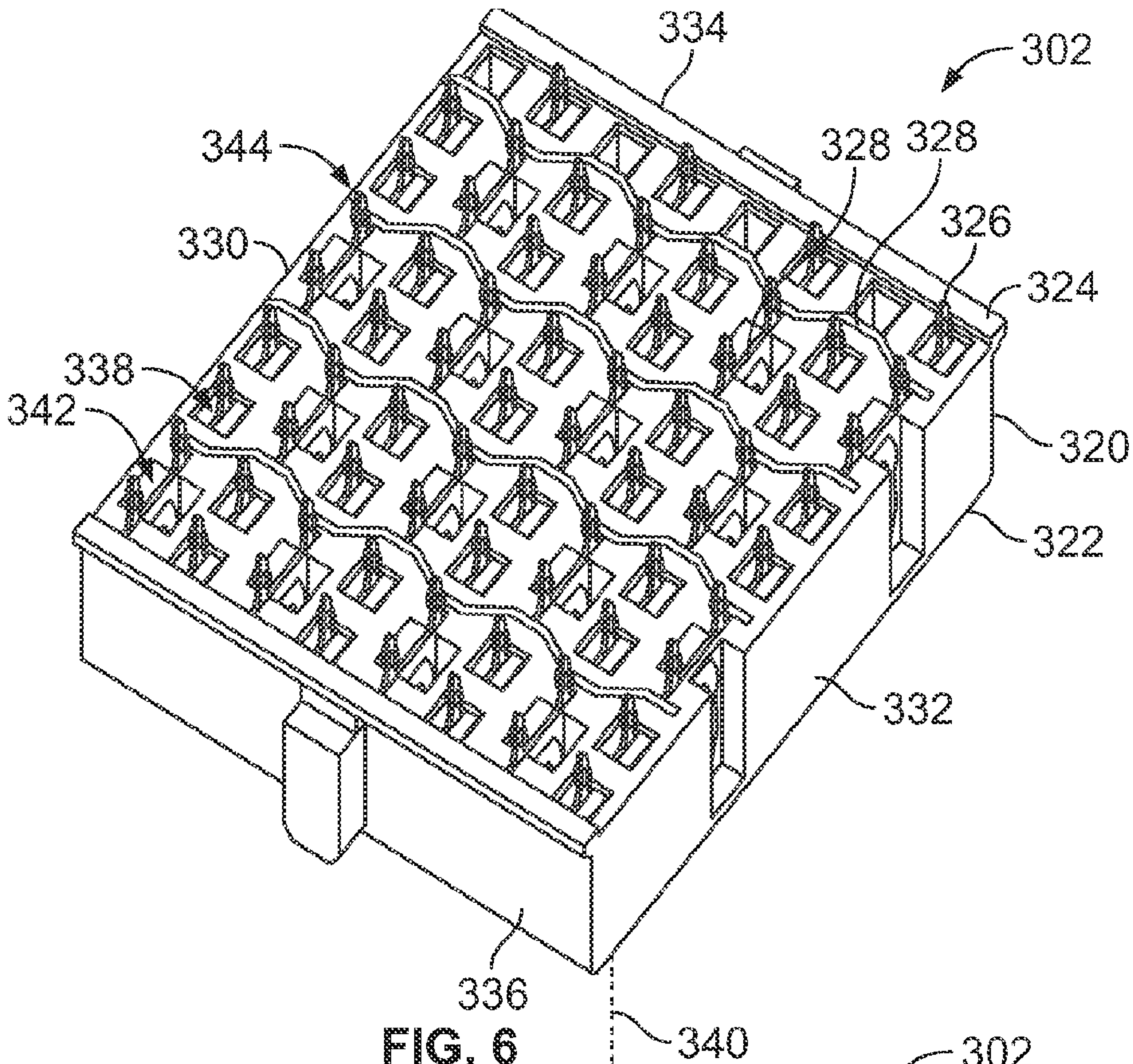
334
302
344
328
328
326
330
324
338
342
320
322
332
336
340

FIG. 6

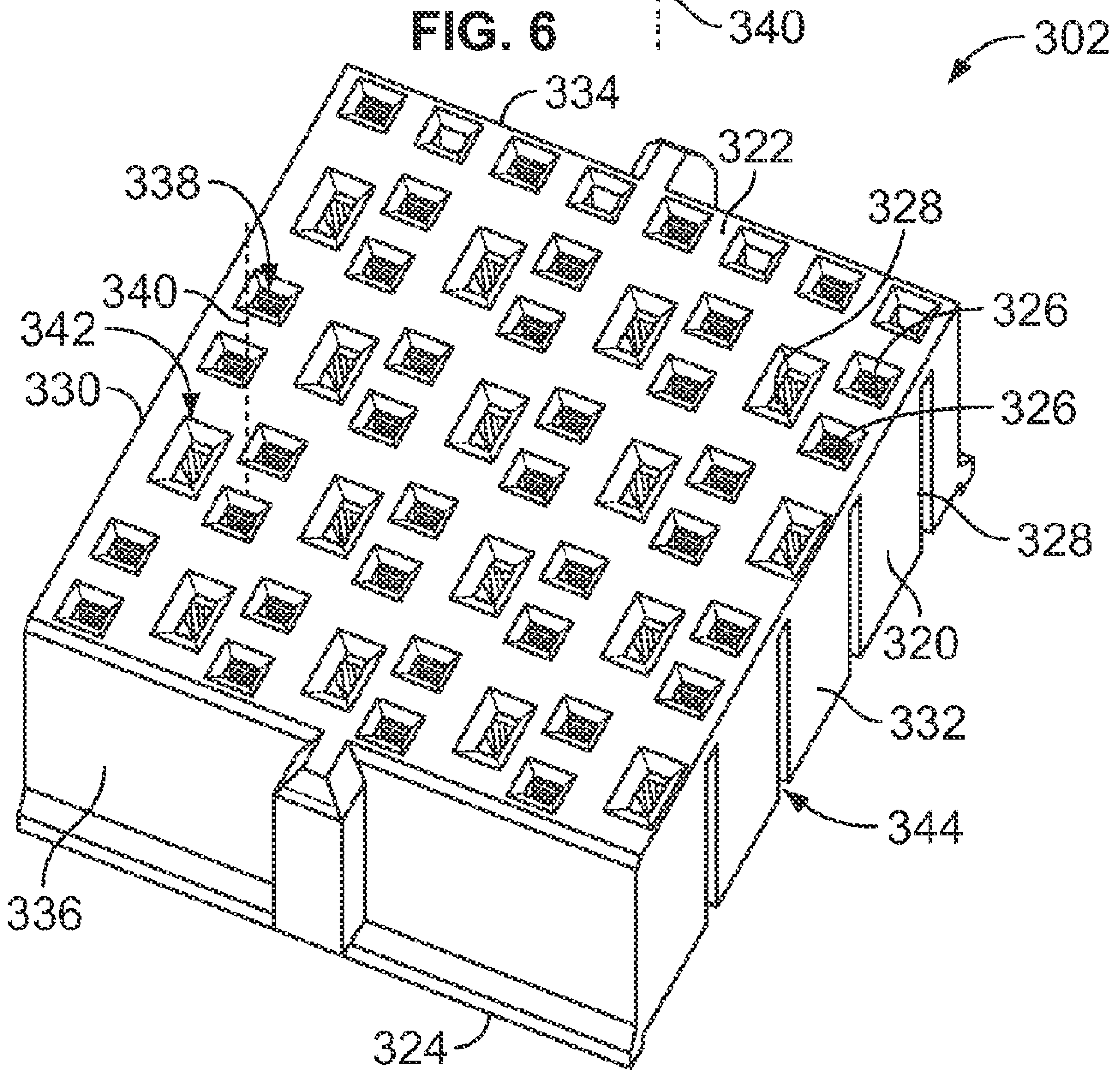
302
334
322
338
328
340
326
342
330
326
328
320
332
344
336
324

FIG. 7

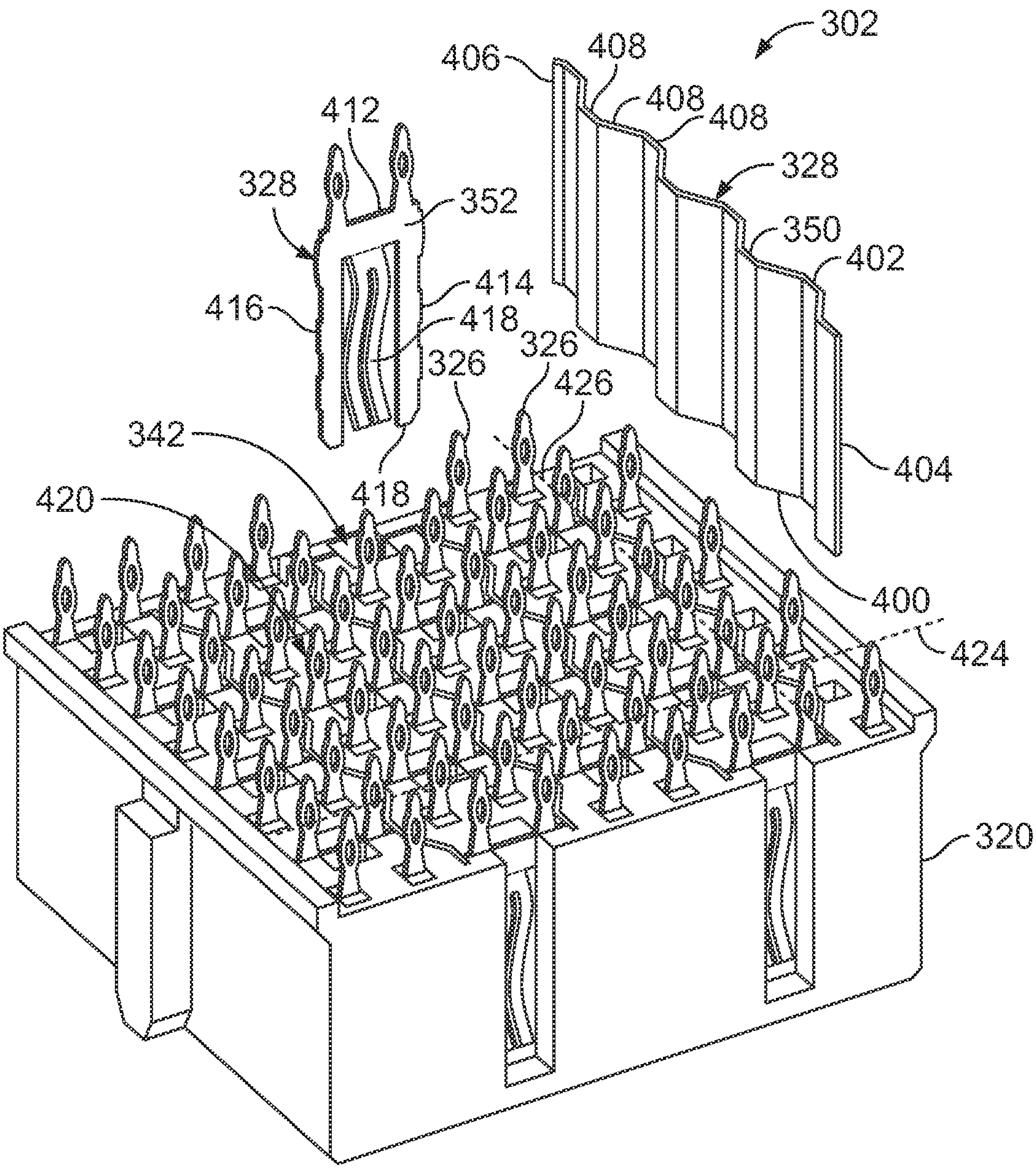
302
406
408
408
408
328
350
402
412
328
352
414
416
418
326
326
426
342
418
420
404
400
424
320

FIG. 8

ELECTRICAL CONNECTOR SYSTEMS

BACKGROUND OF THE INVENTION

The subject matter herein relates generally to electrical connector systems.

Connector systems, such as backplane connector systems, are typically used to connect a one printed circuit board, such as a backplane circuit board, in parallel (perpendicular) with another printed circuit board, such as a daughtercard circuit board. As the size of electronic components is reduced and electronic components generally become more complex, it is often desirable to fit more components in less space on a circuit board or other substrate. Consequently, it has become desirable to reduce the spacing between electrical contacts within backplane connector systems and to increase the number of electrical contacts housed within backplane connector systems. Accordingly, it is desirable to develop backplane connector systems capable of operating at increased speeds, while also increasing the number of electrical contacts housed within the backplane connector system.

At increased speeds, problems arise with signal degradation, such as from cross talk between electrical contacts within the backplane connector systems. Electrical shielding is typically provided in the form of ground contacts interspersed between the signal contacts, however such systems have limited success, particularly at higher speeds.

A need remains for a backplane connector system having improved electrical shielding and performance.

BRIEF DESCRIPTION OF THE INVENTION

In one embodiment, an electrical connector system is provided including a backplane connector having a housing, signal contacts held by the housing and shield plates held by the housing. The housing includes a front and a rear. The housing includes signal channels extending along mating axes thereof between the front and the rear. The signal channels receive corresponding signal contacts. The housing includes slots that receive the shield plates. The signal contacts extend along the mating axes and are arranged in pairs carrying differential signals. The shield plates are electrically conductive and extend generally parallel to the mating axes between corresponding pairs of signal contacts to entirely peripherally surround the pairs of signal contacts to provide electrical shielding for the pairs of signal contacts.

Optionally, the signal contacts may extend lengths within the signal channels with the shield plates entirely surrounding the pairs of signal contacts along the entire lengths of the signal contacts. The shield plates may form prism shaped cavities entirely peripherally surrounding corresponding pairs of signal contacts. Each shield plate may surround more than one pair of signal contacts. The shield plates may engage at least two other shield plates.

In another embodiment, an electrical connector system is provided having a backplane connector including a housing, signal contacts held by the housing and shield plates held by the housing. The housing includes a front and a rear and opposite first and second sides extending between the front and the rear. The signal contacts are arranged in pairs carrying differential signals arranged in columns parallel to the first and second sides. The shield plates are electrically conductive. The shield plates have a wavy configuration between a first edge and a second edge. The shield plates extend between the first and second edges generally along the columns of the signal contacts such that the shield plates provide electrical shielding between pairs of the signal contacts. The shield plates are arranged in the housing such that the shield plates entirely peripherally surround the pairs of signal contacts to provide electrical shielding for the pairs of signal contacts.

In a further embodiment, an electrical connector system is provided including a backplane connector having a housing, signal contacts held by the housing and shield plates held by the housing. The housing includes a front and a rear and opposite first and second sides extending between the front and the rear. The signal contacts are arranged in pairs carrying differential signals. The pairs of signal contacts are arranged in columns generally parallel to the first and second sides. The pairs of signal contacts are arranged in rows generally perpendicular to the first and second sides. The shield plates are electrically conductive and extend between columns of the pairs of signal contacts and between rows of the pairs of signal contacts such that the shield plates entirely peripherally surround the pairs of signal contacts to provide electrical shielding for the pairs of signal contacts.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an electrical connector system formed in accordance with an exemplary embodiment.

FIG. **2** is a front perspective view of a contact module for a daughtercard connector of the electrical connector system shown in FIG. **1**.

FIG. **3** is a front perspective view of a portion of a backplane connector of the electrical connector system shown in FIG. **1**.

FIG. **4** is a front view of a portion of the backplane connector shown in FIG. **3**.

FIG. **5** is a side view of a portion of the electrical connector system.

FIG. **6** is a front perspective view of a backplane connector formed in accordance with an exemplary embodiment.

FIG. **7** is a rear perspective view of the backplane connector.

FIG. **8** is a rear perspective view of the backplane connector.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** illustrates an electrical connector system **100** formed in accordance with an exemplary embodiment. The electrical connector system **100** includes a backplane connector **102** and a daughtercard connector **104** that are used to electrically connect a backplane circuit board **106** and a daughtercard circuit board **108**. While the electrical connector system **100** is described herein with reference to backplane connectors **102** and daughtercard connectors **104**, it is realized that the subject matter herein may be utilized with different types of electrical connectors other than a backplane connector or a daughtercard connector. The backplane connector **102** and the daughtercard connector **104** are merely illustrative of an exemplary embodiment of an electrical connector system **100** that interconnects a particular type of circuit board, namely a backplane circuit board, with a daughtercard circuit board.

In alternative embodiments, other types of electrical connectors may be utilized. The electrical connectors may be used to electrically connect other types of circuit boards, other than backplane and daughtercard circuit boards. In other alternative embodiments, rather than having board mounted electrical connectors, the electrical connector system **100** may be utilized with one or more cable mounted connectors.

In the illustrated embodiment, the backplane connector **102** constitutes a header connector mounted to the backplane circuit board **106**. The backplane connector **102** is received in a chamber **110** of the daughtercard connector **104** when mated. When the connectors **102**, **104** are mated, the daughtercard circuit board **108** is oriented generally perpendicular with respect to the backplane circuit board **106**.

The daughtercard connector **104** constitutes a right angle connector wherein a mating interface **112** and mounting interface **114** of the daughtercard connector **104** are oriented perpendicular to one another. The daughtercard connector **104** is mounted to the daughtercard circuit board **108** at the mounting interface **114**. Other orientations of the interfaces **112**, **114** are possible in alternative embodiments.

The backplane connector **102** includes a mating interface **116** and a mounting interface **118** that are oriented generally parallel to one another. The backplane connector **102** is mounted to the backplane circuit board **106** at the mounting interface **118**. Other orientations of the interfaces **116**, **118** are possible in alternative embodiments.

The backplane connector **102** includes a housing **120**. The housing **120** has a mating end **122**, also referred to herein as a front **122**, that is loaded into the chamber **110** during mating. The housing **120** has a mounting end **124**, also referred to herein as a rear **124**, which is mounted to the backplane circuit board **106**. The housing **120** holds a plurality of individual signal contacts **126** (shown in FIG. **3**) that extend between the mating interface **116** and the mounting interface **118**. In an exemplary embodiment, the signal contacts **126** are arranged in pairs carrying differential signals. The housing **120** holds a plurality of shield plates **128** (shown in FIG. **3**) that extend between the mating interface **116** and the mounting interface **118**.

The housing **120** includes opposite first and second sides **130**, **132** and opposite first and second ends **134**, **136**. The backplane connector **102** may be oriented such that the first and second ends **134**, **136** define a top and a bottom of the housing **120**. Other orientations are possible, such as an orientation where the first and second sides **130**, **132** define the top and bottom or where the front **122** and rear **124** define the top and bottom of the housing **120**.

The housing **120** includes a plurality of signal channels **138** extending between the front **122** and the rear **124**. The signal channels **138** extend along mating axes **140** and receive the signal contacts **126**. When the backplane connector **102** and daughtercard connector **104** are mated, mating contacts **156** of the daughtercard connector **104** are also received in the signal channels **138**.

The housing **120** includes slots (not shown) that receive the shield plates **128**. The slots are sized and shaped to receive the shield plates **128**. The housing **120** includes a plurality of ground channels **142** extending between the front **122** and the rear **124**. The ground channels **142** are open to the slots. The ground channels provide access to the shield plates **128** held in the slots. The ground channels **142** and slots extend along the mating axes **140** and receive portions of the shield plates **128**. When the backplane connector **102** and daughtercard connector **104** are mated, ground contacts **158** of the daughtercard connector **104** are also received in the ground channels **142**. Any number of ground channels **142** may be provided. The ground channels **142** may be provided at any locations within the housing **120**. In an exemplary embodiment, the ground channels **142** are generally positioned between pairs of signal channels **138**, to correspond to positions of the shield plates **128** and ground contacts **158** between pairs of the signal contacts **126** and mating contacts **156**. For example, the ground channels **142** may be aligned in rows and in columns with the signal channels **138**. The columns may be generally parallel to the sides **130**, **132** and the rows may be generally perpendicular to the sides **130**, **132**.

The daughtercard connector **104** includes a housing **150** holding a plurality of contact modules **152** therein. The contact modules **152** hold pairs **154** of individual mating contacts **156** that extend between the mating interface **112** and the mounting interface **114**. The mating contacts **156** are configured to be mated with and electrically connected to the signal contacts **126** of the backplane connector **102**. The contact modules **152** hold the individual ground contacts **158** that extend between the mating interface **112** and the mounting interface **114**. The ground contacts **158** are configured to be mated with, and electrically connected to, the shield plates **128** of the backplane connector **102**.

As described in further detail below, the shield plates **128** entirely peripherally surround the pairs of signal contacts **126** to provide electrical shielding for the pairs of signal contacts **126**. In an exemplary embodiment, entire, 360° shielding is provided by the shield plates **128** along the length of the signal contacts **126**. The shield plates **128** surround portions of the mating contacts **156** when the connectors **102**, **104** are mated. The shield plates **128** provide shielding along the entire mating interface with the mating contacts **156**. The shield plates **128** may control electrical characteristics at the mating interfaces **112**, **116**, such as by controlling cross talk, signal radiation or other electrical characteristics.

FIG. **2** is a front perspective view of one of the contact modules **152** formed in accordance with an exemplary embodiment. The mating contacts **156** and ground contacts **158** are shown extending from the mating interface **112** and the mounting interface **114**. In an exemplary embodiment the contact module **152** includes a dielectric body **160** holding the mating contacts **156** and ground contacts **158**. In an exemplary embodiment, the dielectric body **160** is over molded over the mating contacts **156** and ground contacts **158**. For example, the mating contacts **156** and the ground contacts **158** may be initially held together as part of a common lead frame that is over molded with a plastic material to form the dielectric body **160**. The contact module **152** may be manufactured by other methods or processes in alternative embodiments.

At the mating interface **112**, the mating contacts **156** have mating portions **162** extending forward from a front edge **164** of the dielectric body **160**. In the illustrated embodiment, the mating portions **162** constitute pins that are configure to be mated with corresponding signal contacts **126** (shown in FIG. **3**). The mating portions **162** may be other types of contacts in alternative embodiments, including sockets, spring beams, or other types of contacts.

At the mounting interface **114** the mating contacts **156** including mounting portions **166** extending from a bottom edge **168** of the dielectric body **160**. In the illustrated embodiment, the mounting portions **166** constitute compliant pins, such as eye of the needle contacts, configured to be inserted into the daughter card circuit board **108** (shown in FIG. **1**). Other type of contacts may be provided to define the mounting portions **166** for terminating the mating contacts **156** to the daughter card circuit board **108**. For example, surface mounting tails may be provided to surface mount the mating contacts **156** to the daughter card circuit board **108**.

At the mating interface **112**, the ground contacts **158** have mating portions **172** extending forward from the front edge **164** of the dielectric body **160**. In the illustrated embodiment, the mating portions **172** constitute spring beams that are configure to be mated with corresponding shield plates **128** (shown in FIG. **3**). The spring beams may be deflected and spring biased against the shield plates **128** when mated thereto. The mating portions **172** may be other types of contacts in alternative embodiments, including pins, sockets, blades, or other types of contacts.

At the mounting interface **114** the ground contacts **158** including mounting portions **176** extending from the bottom edge **168** of the dielectric body **160**. In the illustrated embodiment, the mounting portions **176** constitute compliant pins, such as eye of the needle contacts, configured to be inserted into the daughter card circuit board **108** (shown in FIG. **1**). Other type of contacts may be provided to define the mounting portions **176** for terminating the ground contacts **158** to the daughter card circuit board **108**. For example, surface mounting tails may be provided to surface mount the ground contacts **158** to the daughter card circuit board **108**.

FIG. **3** is a front perspective view of a portion of the backplane connector **102** coupled to the backplane circuit board **106** with the housing **120** removed to illustrate the signal contacts **126** and shield plates **128**. The shield plates **128** entirely peripherally surround the pairs of signal contacts **126** to provide electrical shielding for the pairs of signal contacts **126**.

The signal contacts **126** have mating portions **180** configured to be mated with corresponding mating contacts **156** (shown in FIG. **2**). In the illustrated embodiment, the mating portions **180** constitute sockets configured to receive the mating contacts **156**. The sockets are box-shaped to receive the mating contacts **156** therein. The mating portions **180** have spring fingers **182** that press against the mating contacts **156** when loaded therein. Other types of contacts may be provided in alternative embodiments other than sockets for mating with corresponding mating contacts **156**. The signal contacts **126** including mounting portions **184** terminated to the backplane circuit board **106**. In the illustrated embodiment, the mounting portions **184** constitute complaint pins, such as eye of the needle pins. Other types of contacts may be provided in alternative embodiments to define the mounting portions **184**. The mounting portions **184** are received in vias **186** in the backplane circuit board **106** to electrically connect the signal contacts **126** to corresponding traces on the backplane circuit board **106**. The signal contacts **126** extend from a first side **188** of the backplane circuit board **106** to a tip **190** distal from the first side **188**. The tip **190** is located a length **192** from the first side **188**. In an exemplary embodiment, the length **192** is short enough that the signal contacts **126** remain interior of corresponding signal channels **138** (shown in FIG. **1**) of the housing **120** (shown in FIG. **1**).

The shield plate **128** electrically shields pairs of signal contacts **126** from other pairs of signal contacts **126**. The shield plate **128** extends between a front edge **200** and a rear edge **202**. In an exemplary embodiment, the rear edge **202** abuts against the first side **188** of the backplane circuit board **106**. The rear edge **202** is position proximate to the rear **124** (shown in FIG. **1**) of the housing **120**. The front edge **200** is configured to be proximate to the front **122** (shown in FIG. **1**) of the housing **120**. In an exemplary embodiment, the shield plates **128** remain interior of the housing **120**.

The shield plates **128** are elongated between a first edge **204** and a second edge **206**. In an exemplary embodiment, the shield plates **128** are non-planar. The shield plates **128** have a wavy configuration to pass between and along pairs of signal contacts **126**. Optionally, the shield plates **128** may be located as far from the signal contacts **126** as possible. For example, the shield plates **128** may be shaped to be positioned generally equidistant from adjacent signal contacts **126**.

In an exemplary embodiment, each shield plate **128** includes a plurality of walls **208** angled with respect to one another at lines of intersection **210**. In alternative embodiments, the walls **208** may have curved transitions rather than angled transitions at the lines of intersection **210**. In an exemplary embodiment, each shield plate **128** extends along multiple pairs of signal contacts **126**. The shield plates **128** engage other shield plates **128** to electrically common the shield plates **128** together. In an exemplary embodiment, the shield plates **128** form cavities **212** around the pairs of signal contacts **126**. The cavities **212** may have any shape depending on the shapes of the shield plates **128**. In the illustrated embodiments, the cavities **212** are prism-shaped extending along the lengths **192** of the signal contacts **126** from the first side **188** of the backplane circuit board **106** to the front edge **200** of the shield plate **128**. In the illustrated embodiment, the cavities **212** are hexagonal prism-shaped defined by six walls **208** of corresponding shield plates **128**. For example, the cavities **212** may be formed by three walls **208** of one shield plate **128** and three walls **208** of an adjacent shield plate **128**.

In an exemplary embodiment, the signal contacts **126** are arranged in columns along column axes **214** and in rows along row axes **216**. The signal contacts **126** within each pair are aligned along the column axes **214**. The walls **208** of the shield plates **128** include separating walls **218** between pairs of signal contacts **126** and transition walls **220** extending between separating walls **218**. Some of the separating walls **218** are positioned between signal contacts **126** in different columns. Other separating walls **218** extend between pairs of signal contacts **126** in different rows. The transition walls **220** extend therebetween and extend between signal contacts **126** that are in different rows and in different columns. In an exemplary embodiment, column bi-sectors **222** are defined extending between signal contacts **126** within the same column. The separating walls **218** extend along and/or through the column bi-sectors **222**. In an exemplary embodiment, row bisectors **224** are defined extending between signal contacts **126** within the same row. The separating walls **218** extend along and/or through the row bi-sectors **224**. Linking bi-sectors **226** extend between nearest signal contacts **126** in different rows and in different columns. The transition walls **220** extend along and/or through the linking bi-sectors **226**. In an exemplary embodiment, the transition walls **220** extend generally perpendicular with respect to the linking bi-sectors **226**. In an exemplary embodiment, the separating walls **218** extend generally perpendicular to the row bi-sectors **224**. In an exemplary embodiment, the separating walls **218** extend generally parallel to the column bi-sectors **222**.

In an exemplary embodiment, within the backplane connector **102**, the separating walls **218** of one shield plate **128** extend along, and abut against, corresponding separating walls **218** of an adjacent shield plate **128**. The transition walls **220** of a given shield plate **128** generally extend between a separating wall **218** of a shield plate **128** to the left thereof and a separating wall **218** of a shield plate **128** to the right thereof.

FIG. **4** is a front view of the backplane connector **102** with the housing **120** (shown in FIG. **1**) removed to illustrate the layout of the signal contacts **126** and shield plates **128**. The pairs of signal contacts **126** are entirely peripherally surrounded by the shield plates **128**. No gaps or spaces, which could allow EMI leakage between pairs of signal contacts **126**, are provided through or between the shield plates **128**.

FIG. **5** is a side view of the electrical connector system **100** showing the electrical path through the backplane and daughter card connectors **102**, **104**. The housing **120** and the housing **150** (both shown in phantom) are removed to illustrate the signal contacts **126** and the mating contacts **156**. The signal contacts **126** receive the ends of the mating contacts **156** therein. A mating interface, generally identified at numeral

250, is defined along a portion of the mating contacts 156 received in the signal contacts 126.

The signal contacts 126 extend the length 192 from the first side 188. In an exemplary embodiment, the shield plates 128 extend from the first side 188 a distance 252 generally beyond the tips 190 of the signal contacts 126. The distance 252 is at least as long as the length 192 of the signal contacts 126 measured from the first side 188 to provide electrical shielding along the entire length of the signal contacts 126. The shield plates 128 provide shielding for portions of the mating contacts 156, such as those portions of the mating contacts 156 at the mating interface 250.

FIGS. 6 and 7 are front and rear perspective views of a backplane connector 302 formed in accordance with an exemplary embodiment. The backplane connector 302 may be used in place of the backplane connector 102 (shown in FIG. 1) within the electrical connector system 100 (shown in FIG. 1).

The backplane connector 302 includes a housing 320. The housing 320 has a mating end 322, also referred to herein as a front 322, that is loaded into the chamber 110 (shown in FIG. 1) during mating. The housing 320 has a mounting end 324, also referred to herein as a rear 324, which is mounted to the backplane circuit board 106 (shown in FIG. 1). The housing 320 holds a plurality of individual signal contacts 326 that extend between the front 322 and the rear 324. In an exemplary embodiment, the signal contacts 326 are arranged in pairs carrying differential signals. The housing 320 holds a plurality of shield plates 328 (shown in more detail in FIG. 8) that extend between the front 322 and the rear 324. The housing 320 includes opposite first and second sides 330, 332 and opposite first and second ends 334, 336.

The housing 320 includes a plurality of signal channels 338 extending between the front 322 and the rear 324. The signal channels 338 extend along mating axes 340 and receive the signal contacts 326. When the backplane connector 302 and daughtercard connector 104 are mated, mating contacts 156 (shown in FIG. 1) of the daughtercard connector 104 are also received in the signal channels 338.

The housing 320 includes slots 344 that receive the shield plates 328. The slots 344 are sized and shaped to receive the shield plates 328. The slots 344 are open at the rear 324. The housing 320 includes a plurality of ground channels 342 extending between the front 322 and the rear 324. The ground channels 342 are open to the slots 344. The ground channels 342 are open at the front 322 to receive the ground contacts 158 (shown in FIG. 1) of the daughtercard connector 104. The ground channels 342 and signal channels 338 are aligned in rows and in columns. The columns may be generally parallel to the sides 330, 332 and the rows may be generally perpendicular to the sides 330, 332.

As described in further detail below, the shield plates 328 entirely peripherally surround the pairs of signal contacts 326 to provide electrical shielding for the pairs of signal contacts 326. In an exemplary embodiment, entire, 360° shielding is provided by the shield plates 328 along the length of the signal contacts 326. The shield plates 328 may control electrical characteristics of the signal paths of the signal contacts 326, such as by controlling cross talk, signal radiation or other electrical characteristics.

FIG. 8 is a rear perspective view of the backplane connector 302 illustrating some of the shield plates 328 poised for loading into the housing 320. The shield plates 328 entirely peripherally surround the pairs of signal contacts 326 to provide electrical shielding for the pairs of signal contacts 326. The shield plates 328 electrically shield pairs of signal contacts 326 from other pairs of signal contacts 326.

In an exemplary embodiment, the backplane connector 302 includes different types of shield plates 328 that are connected together to form shielded pockets or cavities for the pairs of signal contacts 326. For example, in the illustrated embodiment, the backplane connector 302 includes primary shield plates 350 and secondary shield plates 352. The secondary shield plates 352 extend between, and electrically connect, two primary shield plates 350.

Each primary shield plate 350 extends between a front edge 400 and a rear edge 402. In an exemplary embodiment, the rear edge 402 may abut against the backplane circuit board 106 (shown in FIG. 1). The primary shield plates 350 are elongated between a first edge 404 and a second edge 406. In an exemplary embodiment, the primary shield plates 350 are non-planar. The primary shield plates 350 have a wavy configuration to pass between and along multiple pairs of signal contacts 326.

In an exemplary embodiment, each primary shield plate 350 includes a plurality of walls 408 angled with respect to one another. In alternative embodiments, the walls 408 may have curved transitions rather than angled transitions. In an exemplary embodiment, each primary shield plate 350 extends along multiple pairs of signal contacts 326.

Each secondary shield plate 352 extends between a front edge 410 and a rear edge 412. In an exemplary embodiment, the rear edge 412 may abut against the backplane circuit board 106. The secondary shield plate 352 is elongated between a first edge 414 and a second edge 416. In an exemplary embodiment, the secondary shield plate 352 is generally planar, for example along the legs at the first and second edges 414, 416. The secondary shield plate 352 has a spring beam 418 having a curved shape. The spring beams 418 are received in corresponding ground channels 342 (shown in FIG. 6). The spring beams 418 are designed to be biased against the ground contacts 158 (shown in FIG. 1) to ensure electrical contact between the shield plates 328 and the ground contacts 158.

The secondary shield plates 352 are positioned between, and engage, the primary shield plates 350 to electrically common the primary shield plates 350 together. The first and second edges 414, 416 are pressed against corresponding walls 408 of the primary shield plates 350. In an exemplary embodiment, the shield plates 328 form cavities 420 around the pairs of signal contacts 326. The cavities 420 may have any shape depending on the shapes of the shield plates 328. In the illustrated embodiments, the cavities 420 are prism-shaped extending along the signal contacts 326. In the illustrated embodiment, the cavities 420 are octagonal prism-shaped defined by three walls 408 of one primary shield plates 350, one secondary shield plate 352, three walls 408 of another primary shield plates 350, and another secondary shield plate 352.

In an exemplary embodiment, the signal contacts 326 are arranged in columns along column axes 424 and in rows along row axes 426. The signal contacts 326 within each pair are aligned along the column axes 424. The primary shield plates 350 generally extend parallel to the row axes 426. The primary shield plates 350 extend between pairs of signal contacts 326 within the same column. The secondary shield plates 352 generally extend parallel to the column axes 424. The secondary shield plates 352 extend between pairs of signal contacts 326 in different columns. Optionally, the secondary shield plates 352 may be aligned, in-column, with some signal contacts 326 and in-row with other signal contacts 326.

The pairs of signal contacts 326 are entirely peripherally surrounded by the shield plates 328. No gaps or spaces, which could allow EMI leakage between pairs of signal contacts **326**, are provided through or between the shield plates **328**.

It is to be understood that the above description is intended to be illustrative, and not restrictive. For example, the above-described embodiments (and/or aspects thereof) may be used in combination with each other. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from its scope. Dimensions, types of materials, orientations of the various components, and the number and positions of the various components described herein are intended to define parameters of certain embodiments, and are by no means limiting and are merely exemplary embodiments. Many other embodiments and modifications within the spirit and scope of the claims will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein." Moreover, in the following claims, the terms "first," "second," and "third," etc. are used merely as labels, and are not intended to impose numerical requirements on their objects. Further, the limitations of the following claims are not written in means-plus-function format and are not intended to be interpreted based on 35 U.S.C. §112, sixth paragraph, unless and until such claim limitations expressly use the phrase "means for" followed by a statement of function void of further structure.

What is claimed is:

1. An electrical connector system comprising:

a backplane connector comprising a housing, signal contacts held by the housing and shield plates held by the housing;

the housing includes a front and a rear, the housing includes signal channels extending along mating axes thereof between the front and the rear, the signal channels receive corresponding signal contacts, the housing includes slots that receive the shield plates;

the signal contacts extend along the mating axes, the signal contacts are arranged in pairs carrying differential signals, pairs of signal contacts being arranged in columns along column axes perpendicular to the mating axes;

the shield plates are electrically conductive, the shield plates extend generally parallel to the mating axes between corresponding pairs of signal contacts to entirely peripherally surround the pairs of signal contacts to provide electrical shielding for the pairs of signal contacts, the shield plates having separating walls aligned between pairs of the signal contacts and transition walls extending between separating walls, the separating walls being parallel to the column axes, the transition walls being angled non-orthogonal to the separating walls.

2. The electrical connector system of claim **1**, wherein the signal contacts extends lengths within the signal channels, the shield plates entirely surrounding the pairs of signal contacts along the entire lengths of the signal contacts.

3. The electrical connector system of claim **1**, wherein the shield plates have a front edge and a rear edge, the front edge being proximate the front of the housing, the rear edge being proximate the rear of the housing.

4. The electrical connector system of claim **1**, wherein the shield plates form prism shaped cavities entirely peripherally surrounding corresponding pairs of signal contacts.

5. The electrical connector system of claim **1**, wherein each shield plate bounds more than one pair of signal contacts.

6. The electrical connector system of claim **1**, wherein the shield plates are configured to engage at least two other shield plates.

7. The electrical connector system of claim **1**, wherein the pairs of signal contacts are arranged in columns and rows, the pairs of signal contacts in adjacent columns being in different rows.

8. The electrical connector system of claim **7**, wherein the shield plates are oriented along column bi-sectors extending between signal contacts within the same column, along row bisectors extending between signal contacts within the same row, and along linking bisectors extending between nearest signal contacts in different rows and different columns.

9. The electrical connector system of claim **1** further comprising a backplane circuit board, the backplane connector being mounting to the backplane circuit board, the signal contacts being terminated to the backplane circuit board and extending from a first side of the backplane circuit board, the shield plates being terminated to the backplane circuit board and extending from the first side of the backplane circuit board, the shield plates extending a distance from the first side, the distance being at least as long as a length of the signal contacts measured from the first side.

10. The electrical connector system of claim **1**, wherein the housing includes opposite first and second sides and opposite first and second ends extending between the front and the rear of the housing, the shield plates having a wavy configuration between first and second edges, the first edge being positioned proximate to the first side or the first end, the second edge being positioned proximate to the second side or the second end, the shield plates passing along at least two pairs of signal contacts.

11. The electrical connector system of claim **1**, wherein the shield plates comprise primary shield plates and secondary shield plates, the primary shields plates being elongated, having a wavy configuration, and extending along at least two pairs of signal contacts, the secondary shields plates positioned between and electrically connecting adjacent primary shield plates.

12. The electrical connector system of claim **11**, wherein the pairs of signal contacts are surrounded by two primary shield plates and two secondary shield plates.

13. An electrical connector system comprising:

a backplane connector comprising a housing, signal contacts held by the housing and shield plates held by the housing;

the housing includes a front and a rear, the housing includes opposite first and second sides extending between the front and the rear;

the signal contacts are arranged in pairs carrying differential signals, the pairs of signal contacts are arranged in columns parallel to the first and second sides;

the shield plates are electrically conductive, the shield plates have a plurality of separating walls and a plurality of transition walls between corresponding separating walls, the transition walls being angled at acute angles relative to the separating walls, the separating walls and transition walls having a wavy configuration between a first edge and a second edge, the shield plates extend between the first and second edges generally along the columns of the signal contacts such that the shield plates provide electrical shielding between pairs of the signal contacts, the shield plates are arranged in the housing such that the shield plates entirely peripherally surround the pairs of signal contacts to provide electrical shielding for the pairs of signal contacts.

14. The electrical connector system of claim **13**, wherein the signal contacts extends lengths within the signal channels, the shield plates entirely surrounding the pairs of signal contacts along the entire lengths of the signal contacts.

15. The electrical connector system of claim **13**, wherein the shield plates form prism shaped cavities entirely peripherally surrounding corresponding pairs of signal contacts.

16. The electrical connector system of claim **13**, wherein the shield plates are configured to engage at least two other shield plates.

17. The electrical connector system of claim **13**, wherein the pairs of signal contacts are arranged in columns and rows, the pairs of signal contacts in adjacent columns being in different rows, wherein the shield plates are oriented along column bi-sectors extending between signal contacts within the same column, along row bisectors extending between signal contacts within the same row, and along linking bi-sectors extending between nearest signal contacts in different rows and different columns.

18. The electrical connector system of claim **13**, wherein the shield plates comprise primary shield plates and secondary shield plates, the primary shields plates being elongated, having a wavy configuration, and extending along at least two pairs of signal contacts, the secondary shields plates positioned between and electrically connecting adjacent primary shield plates.

19. An electrical connector system comprising:

a backplane connector comprising a housing, signal contacts held by the housing and shield plates held by the housing;

the housing includes a front and a rear, the housing includes opposite first and second sides extending between the front and the rear;

the signal contacts are arranged in pairs carrying differential signals, the pairs of signal contacts are arranged in columns generally parallel to the first and second sides, the pairs of signal contacts are arranged in rows generally perpendicular to the first and second sides;

the shield plates are electrically conductive, the shield plates extend between columns of the pairs of signal contacts and the shield plates extend between rows of the pairs of signal contacts with walls that form prism shaped cavities that entirely peripherally surround the pairs of signal contacts to provide electrical shielding for the pairs of signal contacts, the prism shaped cavities being formed by more than four walls of corresponding shield plates.

20. The electrical connector system of claim **19**, wherein at least some of the walls of the shield plates forming the prism shaped cavities are angled at acute angles relative to adjacent walls.

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